TALOE

EDEN Workshop F4 - 12 June 2014, Zagreb 16:00 – 17:30

TALOE – Time to Assess Learning Outcomes in Education

Objective: Identify Type of Learning Outcome of selected case study

Types of Cognitive Processes to classify Learning Outcome

Categories and cognitive processes	Alternative names	Definition
1. Remember		Retrieve relevant knowledge from long-term memory
	Identifying	Locating knowledge in long-term memory that is consistent with presented material
	Retrieving	Retrieving relevant knowledge from long-term memory
2. Understand		Construct meaning from instructional messages, including oral, written, and graphic communication
	Clarifying, paraphrasing, representing, translating	Changing from one form of representation to another
	Illustrating, instantiating	Finding a specific example or illustration of a concept or principle
	Categorizing, subsuming	Determining that something belongs to a category
	Abstracting, generalizing	Abstracting a general theme or a major point
	Concluding, extrapolating, interpolating, predicting	Drawing a logical conclusion from presented information
	Contrasting, mapping, matching	Detecting correspondences between two ideas, objects an the like
	Constructing models	Constructing a cause-and-effect model of a system
3. Apply		Carry out or use a procedure in a given situation
	Carrying out	Applying a procedure to a familiar task
	Using	Applying a procedure to an unfamiliar task
4. Analyse		Break material into its constituent parts and determine how the parts relate to one another and to an overall structure
	Discriminating, distinguishing, focusing, selecting	Distinguishing relevant from irrelevant parts or important from unimportant parts of presented material
	Finding coherence, integrating, outlining, parsing, structuring	Determining how elements fit or function within a structure
	Deconstructing	Determining a point of view, bias, values, or intent underlying presented material
5. Evaluate		Make judgments based on criteria and standards
	Coordinating, detecting, monitoring, testing	Detecting inconsistencies or fallacies within a process or product; determining whether a process or product has internal consistency; detecting the effectiveness of a procedure as it is being implemented
	Judging	Detecting inconsistencies between a product and external criteria, determining whether a product has external consistency; detecting the appropriateness of a procedure for a given problem
6. Create		Put elements together to form a coherent or functional whole; reorganize elements into a new pattern or structure.
	Hypothesizing	Coming up with an alternative hypothesis based on criteria
	Designing	Devising a procedure for accomplishing some task
	Constructing	Inventing a product

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TALOE WEBTOOL – DESCRIPTION OF ASSESSMENT METHODS

(matrixes have to be created for each separate sub-category of assessment)

MULTIPLE CHOICE QUESTIONS (MCQ)

MCQ consists of a question followed by alternative answers from which the student has to choose the most correct alternative. The alternative answers may be of the binary type like true/ false or include several alternative answers.

- Remember
  - Response requires recall or recognition of one item correct information
  - Question includes who, what, why, when, where, which, choose, find, how, define, label, show, spell, list, match, name, relate, tell, recall, select
- Understand
  - Response requires recall of more than one correct item of information, may involve a number of unconnected items
  - Test item asks to compare, contrast, demonstrate, interpret, explain, extend, illustrate, infer, outline, relate, rephrase, translate, summarize, show, classify
- Apply
  - Student discusses knowledge and consequences, but does not relate evidence to conclusion
  - Test item asks to apply, build, choose, construct, develop, interview, make use of, organize, experiment with, plan, select, solve, utilize model, identify
- Analyse
  - Student correlates and differentiates, is able to distinguish between options
  - Test item asks to discriminate, infer, outline, separate
- Evaluate
  - Student discusses knowledge and consequences and relates evidence to conclusion
  - Test item asks to award, choose, conclude, criticize, decide, defend, determine, dispute, evaluate, judge, justify, measure, compare, mark, rate, recommend, rule on, select, agree, interpret, explain, appraise, ...
- Create
  - Response relates knowledge and consequences together to make a case and a connection to a related area of knowledge beyond the explicit demand of the question
  - Test item asks to build, choose, combine, compose, construct, create, design, develop, estimate, formulate, imagine, invent, make up, originate, plan, predict, propose, solve, suppose, discuss, modify

This classification is useful to map MCQ and SAQs to the taxonomy.

Table 34 - Mapping of assessment based on MCQ to Bloom's revised taxonomy

		MCQ
REMEMBER	**Recognizing**	MCQ Remember
	Recalling	MCQ Remember
UNDERSTAND	**Interpreting**	MCQ Understand
	Exemplifying	MCQ Understand
	Classifying	MCQ Understand

	Summarizing	MCQ Understand
	Inferring	MCQ Understand
	Comparing	MCQ Understand
	Explaining	MCQ Understand
APPLY	**Executing**	MCQ Apply
	Implementing	MCQ Apply
ANALYZE	**Differentiating**	MCQ Analyse
	Organizing	MCQ Analyse
	Attributing	MCQ analyse
EVALUATE	**Checking**	MCQ Evaluate
	Critiquing	MCQ Evaluate
CREATE	**Generating**	
	Planning	
	Producing	

ESSAYS

In an essay the student is expected to produce a structured text that responds to the question or challenge posed by the teacher.

Essay 01	*Speculative essay*
The student is asked to construct an alternative reality and to provide a rationale for his view. The student will start creating the alternative scenario based on what is asked, his own ideas and integrating his previous knowledge related with the topic. It is expected that the student organizes his ideas while describing them and also that he provides an explanation for what he describes. The type of knowledge involved is mostly likely conceptual knowledge but it might integrate factual and procedural knowledge.	
Cognitive process	Understand: interpreting, summarizing, explaining Analyse: organizing Create: generating, producing

Essay 02	*Quote to discuss*
The student is asked to examine a perspective and to discuss it based on his knowledge of the topic. It is expected that the student will recognize the quote and be able to locate it in a context, recalling relevant knowledge related with the topic. The student will then interpret the quote and will deconstruct it to determine the point of view of the author. Finally, the student will make his judgment integrating these processes.	
Cognitive process	Remember: recognizing, recalling Understand: interpreting Analyse: attributing Evaluate: critiquing

Since there does not appear to be a common understanding of the term competence in the literature, learning outcomes have become more commonly used than competences when describing what students are expected to know, understand and/or be able to demonstrate at the end of a module or programme. For that reason, the terms "competence" and "competency" are avoided in this article.

3. How can one write learning outcomes?

The learning outcome approach is, above all, a perspective and a mode of thinking in order to develop valid programmes. While being an essential part of the implementation phase, writing learning outcomes is of course only the visible surface of this perspective, or a consequence of its implementation. Having stated that, this article intends to use "writing" as the key word, but the intention is of course that the writing of these learning outcomes should be preceded by the thinking necessary for this change in approach.

Benjamin Bloom

The work of Benjamin Bloom (1913 – 1999) was found by the staff of University College Cork, Ireland, to provide a useful starting point when writing learning outcomes. Bloom studied in Pennsylvania State University, USA, and graduated with bachelor and master degrees from that institution. He then worked with Ralph Tyler at the University of Chicago and graduated with a PhD in Education in 1942.

Three domains of learning

Bloom was a gifted teacher who carried out research on the development of a classification of levels of thinking during the learning process. He believed that teachers should design lessons and tasks to help students to meet stated objectives. Bloom identified three domains of learning – cognitive, affective and psycho-motor – and within each of these domains he recognised that there was an ascending order of complexity. His work is most advanced in the cognitive domain where he drew up a classification (or taxonomy) of thinking behaviours from the simple recall of facts up to the process of analysis and evaluation. His publication *Taxonomy of Educational Objectives: Handbook 1, the Cognitive Domain* (Bloom et al., 1956) has become widely used throughout the world to assist in the preparation of curriculum and evaluation materials. The taxonomy provides a framework in which one can build upon prior learning to develop more complex levels of understanding.

In recent years, attempts have been made to revise Bloom's Taxonomy (Anderson & Krathwohl, 2001; Krathwohl, 2002) but the original works of Bloom and his co-workers are still the most widely quoted in the literature.

Bloom proposed that the cognitive or knowing domain is composed of six successive levels arranged in a hierarchy as shown in figure C 3.4-1-1.

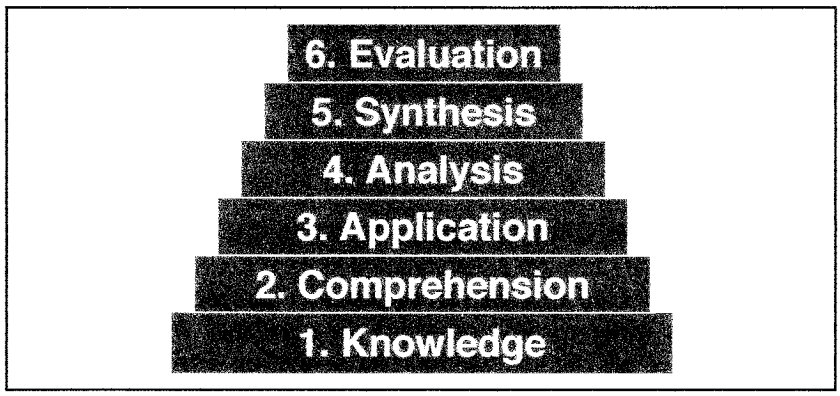

Fig. C 3.4-1-1 Hierarchy of cognitive domain

A hierarchy of thinking processes

Bloom's taxonomy was not simply a classification – it was an effort by him to arrange the various thinking processes in a hierarchy. In this hierarchy, each level depends on the student's ability to perform at the level or levels that are below it. For example, for a student to apply knowledge (stage 3) he or she would need to have both the necessary information (stage 1) and understanding of this information (stage 2).

When talking about teaching, Bloom always advocated that when teaching and assessing students one should bear in mind that learning is a process and that the teacher should try to get the thought processes of the students to move up into the higher order stages of synthesis and evaluation.

3.1 Writing learning outcomes in the cognitive domain

Using correct verbs

Bloom's taxonomy is frequently used for writing learning outcomes, since it provides a ready-made structure and list of verbs. It can be argued that the use of the correct verbs is the key to the successful writing of learning outcomes. Bloom's original list of verbs was limited and has been extended by various authors over the years. The list of verbs given in this article has been compiled from a combination of Bloom's original publication and from the more modern literature in this area. It is not claimed that the list of verbs suggested for each stage is exhaustive, but it is hoped that the reader will find the lists to be reasonably comprehensive.

Action verbs

In the following section, each stage of Bloom's taxonomy is considered and the corresponding list of verbs relating to each stage is proposed. Since learning outcomes are concerned with what the students can **do** at the end of the learning activity, all of these verbs are action (active) verbs.

3.1.1 Knowledge

Assessing knowledge

Knowledge may be defined as the ability to recall or remember facts without necessarily understanding them. Some of the action verbs used to assess knowledge are as follows:

Arrange, collect, define, describe, duplicate, enumerate, examine, find, identify, label, list, memorise, name, order, outline, present, quote, recall, recognise, recollect, record, recount, relate, repeat, reproduce, show, state, tabulate, tell.

Demonstrating evidence of knowledge

Some examples of learning outcomes for courses in various disciplines that demonstrate evidence of knowledge include the following:

- *Recall* genetics terminology: homozygous, heterozygous, phenotype, genotype, homologous chromosome pair, etc.
- *Identify* and consider ethical implications of scientific investigations.
- *Describe* how and why laws change and the consequences of such changes on society.
- *List the criteria to be taken into account when caring for a patient* with tuberculosis.
- *Define* what behaviours constitute unprofessional practice in the solicitor – client relationship.
- *Describe* the processes used in engineering when preparing a design brief for a client.

Note that each learning outcome begins with an action verb.

3.1.2 Comprehension

Assessing comprehension

Comprehension may be defined as the ability to understand and interpret learned information. Some of the action verbs used to assess comprehension are as follows:

Associate, change, clarify, classify, construct, contrast, convert, decode, defend, describe, differentiate, discriminate, discuss, distinguish, estimate, explain, express, extend, generalise, identify, illustrate, indicate, infer, interpret, locate, paraphrase, predict, recognise, report, restate, rewrite, review, select, solve, translate.

Demonstrating evidence of comprehension

Some examples of learning outcomes that demonstrate evidence of comprehension are:

- *Differentiate* between civil and criminal law
- *Identify* participants and goals in the development of electronic commerce.
- *Predict* the genotype of cells that undergo meiosis and mitosis.
- *Explain* the social, economic and political effects of World War I on the post-war world.
- *Classify* reactions as exothermic and endothermic.
- *Recognise* the forces discouraging the growth of the educational system in Ireland in the 19th century.

3.1.3 Application

Assessing application

Application may be defined as the ability to use learned material in new situations, e.g. put ideas and concepts to work in solving problems. Some of the action verbs used to assess application are shown as follows:

Apply, assess, calculate, change, choose, complete, compute, construct, demonstrate, develop, discover, dramatise, employ, examine, experiment, find, illustrate, interpret, manipulate, modify, operate, organise, practice, predict, prepare, produce, relate, schedule, select, show, sketch, solve, transfer, use.

Demonstrating evidence of application

Some examples of learning outcomes that demonstrate evidence of application are:

- *Construct* a timeline of significant events in the history of Australia in the 19th century.
- *Apply* knowledge of infection control in the maintenance of patient care facilities.
- *Select* and employ sophisticated techniques for analysing the efficiencies of energy usage in complex industrial processes.
- *Relate* energy changes to bond breaking and formation.
- *Modify* guidelines in a case study of a small manufacturing firm to enable tighter quality control of production.

- *Show* how changes in the criminal law affected levels of incarceration in Scotland in the 19th century.
- *Apply* principles of evidence-based medicine to determine clinical diagnoses.

3.1.4 Analysis

Assessing analysis

Analysis may be defined as the ability to break down information into its components, e.g. look for inter-relationships and ideas (understanding of organisational structure). Some of the action verbs used to assess analysis are as follows:

Analyse, appraise, arrange, break down, calculate, categorise, classify, compare, connect, contrast, criticise, debate, deduce, determine, differentiate, discriminate, distinguish, divide, examine, experiment, identify, illustrate, infer, inspect, investigate, order, outline, point out, question, relate, separate, sub-divide, test.

Demonstrating evidence of analysis

Some examples of learning outcomes that demonstrate evidence of analysis are:

- *Analyse* why society criminalises certain behaviours.
- *Compare* and contrast the different electronic business models.
- *Debate* the economic and environmental effects of energy conversion processes.
- *Compare* the classroom practice of a newly qualified teacher with that of a teacher of 20 years teaching experience.
- *Calculate* gradient from maps in m, km, % and ratio.

3.1.5 Synthesis

Assessing synthesis

Synthesis may be defined as the ability to put parts together. Some of the action verbs used to assess synthesis are the following:

Argue, arrange, assemble, categorise, collect, combine, compile, compose, construct, create, design, develop, devise, establish, explain, formulate, generalise, generate, integrate, invent, make, manage, modify, organise, originate, plan, prepare, propose, rearrange, reconstruct, relate, reorganise, revise, rewrite, set up, summarise.

Demonstrating evidence of synthesis

Some examples of learning outcomes that demonstrate evidence of synthesis are:

- *Recognise* and formulate problems that are amenable to energy management solutions.
- *Propose* solutions to complex energy management problems both verbally and in writing.
- *Summarise* the causes and effects of the 1917 Russian revolutions.
- *Relate* the sign of enthalpy changes to exothermic and endothermic reactions.
- *Organise* a patient education programme.

3.1.6 Evaluation

Assessing evaluation

Evaluation may be defined as the ability to judge the value of material for a given purpose. Some of the action verbs used to assess evaluation are:

Appraisè, ascertain, argue, assess, attach, choose, compare, conclude, contrast, convince, criticise, decide, defend, discriminate, explain, evaluate, grade, interpret, judge, justify, measure, predict, rate, recommend, relate, resolve,

Demonstrating evidence of evaluation

The following are some examples of learning outcomes that demonstrate evidence of evaluation are:

- Assess the importance of key participants in bringing about change in Irish history Evaluate marketing strategies for different electronic business models.
- Summarise the main contributions of Michael Faraday to the field of electromagnetic induction.
- Predict the effect of change of temperature on the position of equilibrium.
- Evaluate the key areas contributing to the craft knowledge of experienced teachers.

Note that the verbs used in the above six categories are not exclusive to any one particular category. Some verbs appear in more than one category. For example, a mathematical calculation may involve merely applying a given formula (application – stage 3) or it may involve analysis (stage 4) as well as application.